maintaining or alast reside, and completing and evidency to evidence of personal and approximation of the control of personal and approximation of the control of personal and approximation of the control of the abustion of personal and approximation of the control of the abustion of personal and approximation of the approximation of the abustion of the abustion of personal and approximation of the abustion of t	Public reporting burden for th	is collection of information is	estimated to average 4			OMB No. 0704-0188
and processor for networking this body to be	maintaining the data needed.	and completing and review	ing this collection of information	response, including the time for r	eviewing instructions,	searching existing data sources, gathering and
ALTOPIC TO THE ADDRESS Control of Security and Control of Security and Control of Security and Control of Security and Control of Security	including suggestions for radi	roing this burden to Done do		to regarding this ou	inden estimate of any C	Miles aspect of this collection of information
1. REPORT DATE (DO-MM-YYYY) 2. REPORT TYPE Technical Papers 5. DATES COVERED (From - 7c) Technical Papers 5. DATES CO	riignway, Suite 1204, Arlingto	on, VA 22202-4302. Respo	ndents should be aware that notw	ithstanding any other provision of	f law, no person shall h	e subject to any penalty for failing to appeal to the
4. TITLE AND SUBTITLE 4. TITLE AND SUBTITLE 5. CONTRACT NUMBER 5. GRANT NUMBER 5. GRANT NUMBER 5. GRANT NUMBER 5. PROGRAM ELEMENT NUMBER 6. AUTHOR(S) 5. JPROGRAM ELEMENT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AIR FORCE RESEarch (Laboratory (AF	1 DEPORT DATE (O	oes not display a currently v		SE DO NOT RETURN YOUR FO	RM TO THE ABOVE	ADDRESS.
4. TITLE AND SUBTITLE 5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER 5c. PROGRAM ELEMENT NUMBER 5c. PROGRAM ELEMENT NUMBER 23 5 2 5c. TASK NUMBER 17 (2) 5c. TASK NUMBER 18 (2) 5c. TASK NUMBER 19 (3) 5c. TASK NUMBER 10 SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION 18. NUMBER 198. NAME OF RESPONSIBLE PERSON 199. TELEPTONE NUMBER 199. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. LIMITATION 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE PERSON 190. TELEPTONE NUMBER 190. NAME OF RESPONSIBLE 190. NAME OF RESPONSIBLE 10 NAME	. neruni DAIE (D	ט-ועועו-ץ ץ ץ ץ ץ)	2. REPORT TYPE			3. DATES COVERED (From - To)
4. HTHE AND SUBTITLE 5. GRANT NUMBER 5. GRANT NUMBER 5. GRANT NUMBER 5. PROGRAM ELEMENT NUMBER 5. PROGRAM ELEMENT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES 8. SECURITY CLASSIFICATION OF: OF ABSTRACT OF PAGES 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES) 19. NAME OF RESPONSIBLE PERSON DIAM NUMBER (OF PAGES)			Technical Papers			(1011-10)
5. B. GRANT NUMBER 5. PROGRAM ELEMENT NUMBER 5. PROGRAM ELEMENT NUMBER 3.5 2 5. TASK NUMBER 17. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 13. SUPPLEMENTARY NOTES 4. ABSTRACT 15. NUMBER 6. SUBJECT YERMS 5. SECURITY CLASSIFICATION OF: OF ABSTRACT 16. NUMBER OF PAGES 17. LIMITATION OF ABSTRACT OF PAGES 18. NUMBER 198. NAME OF RESPONSIBLE PERSON 199. TELEPHONE NUMBER OF PAGES OF PAGES 190. NAME OF RESPONSIBLE PERSON 199. TELEPHONE NUMBER OF PAGES 190. NAME OF RESPONSIBLE PERSON 199. TELEPHONE NUMBER OF PAGES 190. NAME OF RESPONSIBLE PERSON 190. LIGHT RICHORD NUMBER OF PAGES 190. NAME OF RESPONSIBLE PERSON 190. TELEPHONE NUMBER OF PAGES OF PAGES 190. NAME OF RESPONSIBLE PERSON 190. TELEPHONE NUMBER OF PAGES 190. NAME OF RESPONSIBLE PERSON 190. TELEPHONE NUMBER OF PAGES OF PAGES 190. TELEPHONE NUMBER OF PAGES OF PAGES 190. TELEPHONE NUMBER OF PAGES OF PAGES 190. TELEPHONE NUMBER OF PAGES 190. TELEPHONE NUMBER OF PAGES O	4. TITLE AND SUBTI	TLE				E2 CONTRACT NUMBER
5. PROGRAM ELEMENT NUMBER 5. PROGRAM ELEMENT NUMBER 3. C. Se. TASK NUMBER WI (C. S. Se. TASK NUMBER B. PERFORMING ORGANIZATION REPORT I. S. PERFORMING ORGANIZATION REPORT I. S. PONSOR/MONITOR'S ACRONYM(S) II. SPONSOR/MONITOR'S ACRONYM(S) II. SPONSOR/MONITOR'S NUMBER(S) III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S III. SPONSOR/MONI			·			a. CONTRACT NUMBER
5. PROGRAM ELEMENT NUMBER 5. PROGRAM ELEMENT NUMBER 3. C. Se. TASK NUMBER WI (C. S. Se. TASK NUMBER B. PERFORMING ORGANIZATION REPORT I. S. PERFORMING ORGANIZATION REPORT I. S. PONSOR/MONITOR'S ACRONYM(S) II. SPONSOR/MONITOR'S ACRONYM(S) II. SPONSOR/MONITOR'S NUMBER(S) III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S ACRONYMS III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S III. SPONSOR/MONITOR'S III. SPONSOR/MONI					<u> </u>	The ODANIE W
5. AUTHOR(S) 5. APROJECT NUMBER 2.3 & 2.2 5. TASK NUMBER WI (C ₂) 5. IWORK UNIT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 16. NUMBER 17. LIMITATION OF AGES PERSON L. LIMITATION OF AGES PERSON L. LIMIT RICHEPHONE NUMBER PROTOCULTURE RICHEPHONE NUMB	· ·				1	5b. GRANT NUMBER
5. AUTHOR(S) 5. APROJECT NUMBER 2.3 & 2.2 5. TASK NUMBER WI (C ₂) 5. IWORK UNIT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 16. NUMBER 17. LIMITATION OF AGES PERSON L. LIMITATION OF AGES PERSON L. LIMIT RICHEPHONE NUMBER PROTOCULTURE RICHEPHONE NUMB					i	
5. AUTHOR(S) 5. APROJECT NUMBER 2.3 & 2.2 5. TASK NUMBER WI (C ₂) 5. IWORK UNIT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 16. NUMBER 17. LIMITATION OF AGES PERSON L. LIMITATION OF AGES PERSON L. LIMIT RICHEPHONE NUMBER PROTOCULTURE RICHEPHONE NUMB						SC PROGRAM ELEMENT NUMBER
So. PROJECT NUMBER 3.3 C.2. So. TASK NUMBER N1(_2) St. WORK UNIT NUMBER 3.1 C.2. St. TASK NUMBER N1(_2) St. WORK UNIT NUMBER 3. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRI_PRS 5. Pollux Drive Edwards AFB CA 93524-7048 10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 33. SUPPLEMENTARY NOTES 44. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES 199. NAME OF RESPONSIBLE PERSON Limit Richardson 199. NAME OF RESPONSIBLE PERSON Limit Richardson 199. TELEPHONE NUMBER (probube area offs)					1	OC. THOUTAM ELEMENT NUMBER
So. PROJECT NUMBER 3.3 C.2. So. TASK NUMBER N1(_2) St. WORK UNIT NUMBER 3.1 C.2. St. TASK NUMBER N1(_2) St. WORK UNIT NUMBER 3. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRI_PRS 5. Pollux Drive Edwards AFB CA 93524-7048 10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 33. SUPPLEMENTARY NOTES 44. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES 199. NAME OF RESPONSIBLE PERSON Limit Richardson 199. NAME OF RESPONSIBLE PERSON Limit Richardson 199. TELEPHONE NUMBER (probube area offs)	6. AUTHOR(S)					<u> </u>
56. TRACK JUNIDER WILG J 5f. WORK UNIT NUMBER AFIL/PRS 3 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 10. SPONSORIMONITOR'S ACRONYM(S) 11. SPONSORIMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION OF PAGES 6. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: REPORT D. ABSTRACT 18. NUMBER OF PAGES 19a. NAME OF RESPONSIBLE PROTECTION OF PAGES 19b. NAME OF RESPONSIBLE PROTECTION OF PAGES 10. SPONSORIMONITOR'S ACRONYM(S) 11. SPONSORIMONITOR'S NUMBER(S) 12. DISTRIBUTION OF PAGES 13. NUMBER OF PAGES 15a. NAME OF RESPONSIBLE PROTECTION OF PAGES 15b. NUMBER (OF PAGES) 15c. NAME OF RESPONSIBLE PROTECTION OF PAGES 15c. NUMBER (OF PAGES)	o. Ale monio] :	5d. PROJECT NUMBER
56. TRACK JUNIDER WILG J 5f. WORK UNIT NUMBER AFIL/PRS 3 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 10. SPONSORIMONITOR'S ACRONYM(S) 11. SPONSORIMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION OF PAGES 6. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: REPORT D. ABSTRACT 18. NUMBER OF PAGES 19a. NAME OF RESPONSIBLE PROTECTION OF PAGES 19b. NAME OF RESPONSIBLE PROTECTION OF PAGES 10. SPONSORIMONITOR'S ACRONYM(S) 11. SPONSORIMONITOR'S NUMBER(S) 12. DISTRIBUTION OF PAGES 13. NUMBER OF PAGES 15a. NAME OF RESPONSIBLE PROTECTION OF PAGES 15b. NUMBER (OF PAGES) 15c. NAME OF RESPONSIBLE PROTECTION OF PAGES 15c. NUMBER (OF PAGES)						2362
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 17. LIMITATION OF PAGES 6. SECURITY CLASSIFICATION OF: REPORT D. ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Liginal Richardson Liginal Richardson Liginal Richardson Liginal Richardson Included Responsible Person Report 17. LIMITATION OF PAGES (Include area code)					H-	TACK NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES REPORT D. ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Liliani Richardson 19b. TELEPHONE NUMBER (include averaged)			•		15	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES REPORT D. ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Liliani Richardson 19b. TELEPHONE NUMBER (include averaged)						MIGH
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SECURITY CLASSIFICATION OF: OF ABSTRACT OF PAGES REPORT D. ABSTRACT OF PAGES IT. LIMITATION OF AGSTRACT OF PAGES IT. LIMITATION OF AGSTRACT IT. LIMITATION OF AGSTRACT OF PAGES IT. LIMITATION IT. NUMBER IT. DIA NUMBER IT					<u> </u>	of, WORK UNIT NUMBER
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SECURITY CLASSIFICATION OF: OF ABSTRACT OF PAGES REPORT D. ABSTRACT 15. NUMBER OF PAGES OF PAGES IT. LIMITATION OF AGSTRACT IT. LIMITATION OF AGSTRACT OF PAGES IT. LIMITATION IT. LIMITATION OF AGSTRACT IT. LIMITATION IT. LIMITATION IT. LIMITATION OF AGSTRACT IT. LIMITATION IT. LIMI					1,	, and the model
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSORMONITOR'S ACRONYM(S) 11. SPONSORMONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SECURITY CLASSIFICATION OF: OF ABSTRACT OF PAGES REPORT D. ABSTRACT 15. NUMBER OF PAGES OF PAGES IT. LIMITATION OF AGSTRACT IT. LIMITATION OF AGSTRACT OF PAGES IT. LIMITATION IT. LIMITATION OF AGSTRACT IT. LIMITATION IT. LIMITATION IT. LIMITATION OF AGSTRACT IT. LIMITATION IT. LIMI	7. PERFORMING ORG	GANIZATION NAME	(S) AND ADDRESS(ES)			
ART Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRIL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SECURITY CLASSIFICATION OF: 6. SECURITY CLASSIFICATION OF: 7. LIMITATION OF ABSTRACT 19a. NAME OF RESPONSIBLE PERSON PAGES 19b. TELEPHONE NUMBER (Indicated and acceleration of the person) 19b. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19b. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person) 19c. TELEPHONE NUMBER (Indicated and acceleration of the person)			(ב) עוזה אההטבפפ(בפ)			
AFRLIPES 5 POILUX Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AIRIL/RS 5 Poilux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SECURITY CLASSIFICATION OF: REPORT B. ABSTRACT 17. LIMITATION OF ABSTRACT 18. NUMBER OF ABSTRACT 19. TELEPHONE NUMBER (Indicates on Indicates on Indica	Air Force Decree t	Tahami (1777)	(1)	,	1	REPORT
5 Pollux Drive Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES REPORT D. ABSTRACT C. THIS PAGE A MINIMAL PROPOSITION OF THIS PAGE 18. NUMBER OF RESPONSIBLE PERSON Liain Richardson 195. TELEPHONE NUMBER (MARBER) 196. TELEPHONE NUMBER (MARBER) 197. TELEPHONE NUMBER (MARBER) 198. TELEPHONE NUMBER (MARBER) 199. TELEPHONE NUMBER (MARBER) 199. TELEPHONE NUMBER (MARBER)	All Force Research	Laboratory (AFM	C)			i .
Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 15. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: OF ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES PERSONSIBLE PERSON Deliani Nichardson 19b. TELEPHONE NUMBER (include area code)	AFRL/PRS			•	1	C .
Edwards AFB CA 93524-7048 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 15. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: OF ABSTRACT 17. LIMITATION OF ABSTRACT OF PAGES PERSONSIBLE PERSON Deliani Nichardson 19b. TELEPHONE NUMBER (include area code)	5 Pollux Drive				1)
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: OF ABSTRACT OF PAGES REPORT D. ABSTRACT OF PAGES 10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S) 11. SPONSOR/MONITOR'S NUMBER(S)		3534 7040				N
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	Lawaius AI'D CA	73324-1048	* **	1. 16. 14.	1	
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)						
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	9. SPONSORING / MC	NITORING AGENC	V NAME(S) AND ADDD	CC/EC)		<u> </u>
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF PAGES 19a. NAME OF RESPONSIBLE PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)		Othing AGENC	· MAINE(9) AND ADDRE	:00(E0)	. 1	0. SPONSOR/MONITOR'S
Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 8. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES 199. NAME OF RESPONSIBLE PERSON Leilani Richardson 190. TELEPHONE NUMBER (include area code)	•				1	(CRONYM(S)
AFRL/PRS 6 Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include page ages ode)					İ	-
AFRL/PRS 6 Edwards AFB CA 93524-7048 11. SPONSOR/MONITOR'S NUMBER(S) 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include page ages ode)	Air Force Research	Laboratory (AFM(C)			1
5 Pollux Drive Edwards AFB CA 93524-7048 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 199. TELEPHONE NUMBER (include area code)		, ,	,		<u> </u>	
Edwards AFB CA 93524-7048 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF RESPONSIBLE PERSON Leilani Richardson Leilani Richardson 19b. TELEPHONE NUMBER (Include area code)	-				1	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF RESPONSIBLE PERSON Leilani Richardson 19. TELEPHONE NUMBER (include area code)					j	NUMBER(S)
Approved for public release; distribution unlimited. 3. SUPPLEMENTARY NOTES	Edwards AFB CA 9	3524-7048				
Approved for public release; distribution unlimited. 3. SUPPLEMENTARY NOTES	40 DIOTRICIO					
3. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF ABSTRACT OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	12. DISTRIBUTION / A	VAILABILITY STAT	EMENT			
3. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF ABSTRACT OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)				•		-
3. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF ABSTRACT OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)						1
3. SUPPLEMENTARY NOTES 4. ABSTRACT 5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF ABSTRACT OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	Approved for public	release distribution	n unlimited			i
6. SUBJECT TERMS 6. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	Transactor public		m ammilled.			
6. SUBJECT TERMS 6. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)				•		
6. SUBJECT TERMS 6. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	13. SUPPLEMENTARY	NOTES	***************************************			I
5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF 18. NUMBER OF RESPONSIBLE OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (Include area code)						
5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF 18. NUMBER OF RESPONSIBLE OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (Include area code)				*		4
5. SUBJECT TERMS 6. SECURITY CLASSIFICATION OF: 17. LIMITATION OF 18. NUMBER OF RESPONSIBLE OF ABSTRACT OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (Include area code)	14 ARSTRACT					
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT	T. ADSTRACT					
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						41
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						1
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT		* .				
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						ļ
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT				T.		:
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT						
5. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT	E CUDIECT TENTS					
REPORT b. ABSTRACT c. THIS PAGE D. ABSTRACT	a. SUBJECT TERMS					
REPORT b. ABSTRACT c. THIS PAGE D. ABSTRACT	,					,
REPORT b. ABSTRACT c. THIS PAGE D. ABSTRACT				•		
REPORT b. ABSTRACT c. THIS PAGE D. ABSTRACT	6. SECURITY OF ASSI	FICATION OF		142 111		
REPORT b. ABSTRACT c. THIS PAGE D. ABSTRACT c. THIS PAGE A OF PAGES PERSON Leilani Richardson 19b. TELEPHONE NUMBER (include area code)	- SESSINI CEASSI	TORTION OF:				19a. NAME OF RESPONSIBLE
REPORT b. ABSTRACT c. THIS PAGE A Leilani Richardson 19b. TELEPHONE NUMBER (include area code)				OF ABSTRACT	OF PAGES	PERSON
D. ABSTRACT C. THIS PAGE 19b. TELEPHONE NUMBER (include area code)						
A (include area code)	. REPORT	b. ABSTRACT	c. THIS PAGE	,		
nclassified Unclassified Unclassified (A) (include area code) (661) 275-5015				1 (.)	1	19D. IELEPHONE NUMBER
(661) 275-5015	nclassified	Unclassified	Unalessifica	(A)	1	(Include area code)
		Chclassified	Unclassified			(661) 275-5015

~ REPORT DOCUMENTATION PAGE

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. 239.18

Separate Mens are enclosed

124

Form Approved OMB No. 0704-0188

511

MEMORANDUM FOR PRS (Contractor Publication)

FROM: PROI (STINFO)

20 October 2000

SUBJECT: Authorization for Release of Technical Information, Control Number: AFRL-PR-ED-AB-2000-225 Miller, Tim, "An Experimental Investigation of Cracking Along a Liner-Propellant Interface"

JANNAF 34th Structures & Mechanical Behavior Subcommittee Meeting (Cocoa Beach, FL, 20-26 Mar 2001) (Deadline: 03 Nov 2000)

(Statement A)

d.) appropriateness for release to a foreign nation. Comments:	t controls or distribution restrictions, , and e.) technical sensitivity and/or economic sensitivity.
Signature	Date
and/or b) possible higher headquarters review	Affairs Office for: a.) appropriateness for public release
Signature	Date
3. This request has been reviewed by the STINFO b.) appropriateness of distribution statement, c.) n e.) parallel review completed if required, and f.) f Comments:	military/national critical technology, d.) economic sensitivity, format and completion of meeting clearance form if required
Signature	Date
appropriateness of distribution statement, d.) tech national critical technology, and f.) data rights and	technical accuracy, b.) appropriateness for audience, c.) nical sensitivity and economic sensitivity, e.) military/d patentability

APPROVED / APPROVED AS AMENDED / DISAPPROVED

PHILIP A. KESSEL
Technical Advisor
Missile & Space Propulsion Division

Date

20021119 124

12th Nondestructive Evaluation Subcommittee (NDES)
21st Rocket Nozzle Technology Subcommittee (RNTS)
34th Structures & Mechanical Behavior Subcommittee (S&MBS)
Joint Meeting
26-20 March 2001
Doubletree Oceanfront Hotel, Cocoa Beach, Florida

ABSTRACT

		0
Title of Paper: An Experimental Investigation	of Cracking along a Liner-Propellant Interface	_ (
Author(s): Timothy C. Miller		ر م
Is this paper an update? , Yes , No.	Has it been presented elsewhere?, Yes, No.	_

The fracture of a liner-propellant interface is studied experimentally using a tensile testing apparatus and videotape equipment. Additional experimental methods are used to supplement the conclusions derived from this testing, and computational modeling of the specimens is also performed. The fracture of the bimaterial is governed by the mode mixity and the properties of the constituents, and may involve crack growth along the interface or branching of the crack away from the interface, depending on the specific conditions.